Tonći Svilokos, Ph.D.
University of Dubrovnik
Department of Economics and Business Economics,
Dubrovnik, Croatia
e-mail: tonci.svilokos@unidu.hr

MONETARY POLICY EFFECTIVENESS IN THE PERIOD OF ECONOMIC CRISIS

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Abstract

Since 2007, many monetary authorities have drastically changed its monetary policy. They began an aggressive struggle with the biggest economic crisis since the Great Depression. Despite the substantial decline in Central banks interest rates in US and EMU and despite the sharp easining of monetary policy in many other countries, the cost of credit to both households and businesses has generally risen in almost every country. All this leads to the question of whether monetary policy becomes less effective in periods of recession or not. The goal of this paper is to empirically examine the hypothesis of reduced effectiveness of monetary policy in period of economic crisis. The paper starts with assertions: (i) the money supply, in the narrow sense (M_1) is determined by the monetary base (M_0) and money multiplier (m), and (ii) monetary authority have full control on monetary base, while the money multiplier are only partially determined by monetary authority. It is also determined by the actions of non-banking public and the banks, and because of that monetary policy effectiveness could decrease in the period of economic crisis. Based on a sample of six countries this paper examines the strength of the relationship between monetary aggregates during recessions and in period out of recessions, and according the obtained results appropriate conclusions and explanations are offered.

Keywords: economic crisis, monetary policy effectiveness, monetary aggregates

1. INTRODUCTION

Since 2007, many monetary authorities have drastically changed their monetary policy. They began an aggressive struggle with the biggest economic crisis since the Great Depression. Easy availability of credit in the US and debt-financed consumer spending led to a housing construction boom and Real estate bubble which peaked in 2006. As a part of the housing and credit booms, the financial innovations such as mortgage-backed securities (MBS) and collateralized debt obligations (CDO), which derived their value from mortgage payments and housing prices, significantly increased. When asset prices rise too far out of line with fundamentals, they must come down, and eventually the housing price bubble burst.[1] As housing prices declined, major global financial institutions that had borrowed and invested heavily in subprime MBS reported significant losses. Defaults and losses on other loan types also increased significantly as the crisis expanded from the housing market to other parts of the economy. Total losses are estimated in the trillions of U.S. dollars globally (IMF, 2010). Lehman Brothers was liquidated, Bear Stearns and Merrill Lynch were sold, Goldman Sachs and Morgan Stanley became commercial banks, Fannie Mae and Freddie Mac were placed under control of the U.S. government. These seven institutions were highly leveraged and had 9 trillion USD in debt or guarantee obligations. The crisis rapidly developed and spread into a global economic shock, resulting in a number of European bank failures, declines in various stock indexes, and large reductions in the market value of equities and commodities.

U.S. Federal Reserve and other central banks around the world knows that behaviour which may be optimal for an individual such as saving more during adverse economic conditions can be harmful for economy as a whole. That is because one person's consumption is another person's income. Too many consumers attempting to save (or pay down debt) simultaneously can cause or deepen a recession (that is the paradox of thrift). Because of that, they have taken steps in order to expand money supplies to avoid the risk of a deflationary spiral, in which lower wages and higher unemployment lead to a self-reinforcing decline in global consumption.

FED has eased monetary policy aggressively lowering the federal funds rate target from 5 ¼% in September 2007 to 0 ¼% in December 2008. The ECB also decreased the minimum bid rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility from 4.25%, 5.25% and 3.25%, respectively in September 2008, to 1.50%, 2.50% and 0.50%, respectively in March 2009.

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[1] Although the problem originated in the United States, the wake-up call came from Europe. After Fitch and Standard&Poor's announced ratings downgrades on MBS, a BNP Paribas (French investment house) suspended redemption of shares held in some of its money market funds on August 7, 2008. That shows how extensive the globalization of financial markets had became.

During the last quarter of 2008, these central banks purchased US$2.5 trillion of government debt and troubled private assets from banks. This was the largest liquidity injection into the credit market, and the largest monetary policy action, in world history. The governments of EU and the USA also raised the capital of their national banking systems by $1.5 trillion, by purchasing newly issued preferred stock in their major banks.

In October 2010, Nobel laureate Joseph Stiglitz explained how the U.S. Federal Reserve was implementing another monetary policy —creating currency— as a method to combat the liquidity trap. By creating $600 billion and inserting this directly into banks, the Federal Reserve intended to encourage banks to finance more domestic loans and refinance mortgages. However, banks instead were spending the money in more profitable areas by investing internationally in emerging markets (Stiglitz, 2010).

In Croatia a strong shift in monetary policy has also occurred. The first decision was made in October 2008. That was Decision to abolish the Decision of the marginal reserve requirement in order to increase foreign currency liquidity of banks. Then, in November of the same year, the reserve requirement rate was reduced from 17% to 14% which released 8.4 billion Kuna liquidity. In February 2010 this rate was further reduced to 13%, which freed up another 2.9 billion Kuna for financing government and HBOR programs of encouraging bank credit activity. In January and then again in February 2009 CNB made decisions to reduce the rates of minimum required amount of foreign currency claims, first from 28.5 to 25 percent (in January) and then from 25 to 20 percent (in February), which the banking system allowed free access to a total of 18.25 billion Kuna. In March 2011 CNB Governor made a decision to additional easing of rates of minimum required amount of foreign currency claims from 20 to 17%, which meant for bankers 6.3 billion Kuna of new free funds. All this shows that monetary policy has changed from contractionary to expansionary.

Despite the substantial decline in Central banks interest rates in US and EMU and despite the sharp easining of monetary policy in many other countries, the cost of credit to both households and businesses has generally risen in almost every country. Banks and other financial intermediaries have also sharply tightened credit standards for both household and businesses. In Croatia banks' ınterest rates on Kuna credits indexed to foreign currency and on credits in euros before crises (average for 2006) was 6.32% and in 2009 it was 8.11%. All this leads to the question of whether monetary policy becomes less effective during period of recessions or not. Paul Krugman has expressed his view on this phenomenon in his New York Times column, stating, “We are already, however, well into the realm of what I call depression economics. By that I mean a state of affairs like that of the 1930s in which the usual tools of monetary policy – above all the Federal Reserve’s ability to pump up the economy by cutting interest rates – have lost all traction.” (Krugman, 2008). This view originated from Keynesian discussions of the effectiveness of monetary policy during the Great Depression period (Fishback, 2010). During the great depression of the 1930's, interest rates

dropped below 1%. At this low interest rate, one would think that many businesses would have taken out loans. But this did not happen: the volume of loans also decreased considerably. The reason was that businesses had difficulties staying in business, and banks were afraid to lend them money. Because of the shocks to credit markets from the financial crisis, the argument is that monetary policy is unable to lower the cost of credit.

The goal of this paper is to empirically examine the hypothesis of reduced effectiveness of monetary policy in period of economic crisis. The paper is divided as follows. The part after the introduction contains a brief literature review that can be associated with the issue of the effectiveness of monetary policy and the transfer of monetary decisions into the economy. The third part contains a theoretical framework and starting assumptions. After that follows description of the data and research results in forth part of this paper, while the fifth section makes concluding remarks

2. LITERATURE REVIEW

Slow exit from the economic crisis have raised concerns about whether monetary policy has lost its effectiveness during ongoing financial and economic crisis. Although the role of monetary policy in the economy has been examined extensively in many empirical literature (Keynes, 1936; Tobin, 1965; Friedman, 1968; Barro, 1976; Goodfired & King, 1997; etc.), as well as mechanism of monetary policy transmission into the real economy (Friedman & Swartz, 1963; Bernanke, 1995; Gabe, 2000; Meltzer, 2001; Mishkin, 2007, ect.) analysis of the efficiency of monetary policy under different circumstances was less explored. Among the papers dealing with this issue the following papers should be mentioned.

Gambacorta et.al. (2012) assess the macroeconomic effects of unconventional monetary policies by estimating a panel VAR with monthly data from eight advanced economies over a sample spanning the period since the onset of the global financial crisis. They found that an exogenous increase in central bank balance sheets at the zero lower bound leads to a temporary rise in economic activity and consumer prices, while the impact on the price level is weaker and less persistent.

Abassi and Linzert (2012) analyzed the effectiveness of monetary policy in steering euro area money market rates by looking at the predictability of money market rates on the basis of monetary policy expectations and the impact of extraordinary central bank measures on money market rates. They found that during the crisis money market rates up to 12 months still respond to revisions in the expected path of future rates, even though to a lesser extent than before August 2007. They attribute part of the loss in monetary policy effectiveness to money market rates being driven by higher liquidity premium and increased uncertainty about future interest rates.

Catte et.al. (2011.) investigates the role of macroeconomic policies in the global crisis. They focus on period before crisis (2002–2007) and wonder if the Great Recession was avoidable. They perform a number of counterfactual simulations and conclude that US monetary policy was in analysed period over-expansionary and they think that more effective macro-prudential supervision before crisis would made the Great Recession less drastic.

Bijapura (2009) investigates the effectiveness of monetary policy during a credit crunch by estimating a vector auto regression on the US economy. He presents evidence that interest rate cuts have a diminished impact on growth, due to impairment in the relationship between monetary policy and the supply of intermediated credit

Arestis and Sawyer (2003) in the centre of their research put endogenous of money and use of interest rates as the key element of monetary policy. They notice clear limits on interest rates, notably that nominal interest rates cannot go negative, and the level of international interest rates constrain domestic interest rates. Their results shows that interest rates are relatively ineffective in the control of inflation.

Among domestic (Croatian) authors, the work of Bokan et.al. (2010) should be emphasized. The authors established a dynamic stochastic equilibrium (DSGE) model for Croatia. They examined the results of the simultaneous action of the crisis (which is modelled by proxying it with increase in the foreign interest rate and drop in the demand for Croatian export products) and the Monetary policy response (which is introduced in the form of regulatory requirement reduction). They found that in period of crisis, the Croatian economy declines despite the significant monetary policy reactions. Limitations of the efficiency of monetary authority influences they see in chosen strategy of keeping exchange rate broadly stable and in highly euroized Croatian relatively small and open economy.

3. THEORETICAL FRAMEWORK

Monetary policy is the process by which the monetary authority of a country controls the supply of money for the purpose of promoting economic growth and stability. If monetary authority has difficulties in controlling money supply then it will not be able to act appropriately to the disturbances in the economy. The issue of influence of monetary authority on money supply is the issue of endogeneity of money. Traditionally it was thought that the money supply can be treated as exogenous and its supply is complitely under the control of the Central Bank (as an agent of the government). This classic view assumes that the money supply (M1) is a product of monetary base (B) (reserve money, high-powered money) and money multiplier (m): $M_1 = B \times m$, where the central bank is able to control the monetary base, and money multiplier is stable.

On the other hand, supporters of the post-Keynesian theory (PK) stand that money supply is an endogenous variable, and that means that it is primarily influenced by external factors determined by demand for loans. Central banks has limited control of the money supply and bank reserves. Post Keynesians argue that credit money comes into existence as a result of borrowing from the banks, and it is extinguished as a result of the repayment of bank debt (Kaldor and Trevithick, 1981). Whenever economic actors choose to borrow from their banks, they also make the deposits and bank money are created in that process. Whenever economic actors choose to repay their bank loans, bank money are destroyed. In turn, the terms on which credit money is issued, i.e. the interest rate charged on bank loans and paid on bank deposits, play a crucial role in governing the rate of expansion of the money stock (Moore, 1989).

The concept of endogenous (bank) money is a particularly important one for macroeconomic analysis, especially within Keynesian economics. Bank money provides a more realistic approach to money in comparison with the exogenous, controllable money approach (in the sense that most money in an industrialized economy is bank money). Further, the concept of endogenous money fits well with the current approach to monetary policy based on the setting (or targeting) of a key interest rate. In endogenous-money models, the causal relationship between the stock of money and prices is reversed as compared with the exogenous money case. Endogenous money plays an important role in the causal relationship between investment and savings: simply the availability of loans permits the expansion of investment, which leads to a corresponding expansion of savings and to an expansion of bank deposits, which may later be extinguished as and when loans are paid off.

In order to empirically analyse the ability of monetary authority to control money supply and to influence on macroeconomic real variables such as GDP, real wages or the level of employment, we have to start with the definition of money and base money and how their quantities can be measured in practice.

In practice, the classification of instruments as ‘money’ can be problematic. The various financial instruments differ according to their transactions costs, the range in which they can be used for payment and the extent to which they preserve their value, i.e. the extent they have the functions of money.

The narrowest subset comprises the financial instruments available for payment in the fastest way, at the lowest transaction costs and without restrictions (M_1 money aggregate). It includes currency in circulation (banknotes and coins - G) + demand deposits available for direct payment (D). Demand deposits includes government deposits within Central banks, households and enterprises deposits within commercial banks:

$$M_1 = G + D \quad (1)$$

In addition to the above, the broader categories of money (M_2 and M_3 money aggregates) also include the less liquid liabilities of monetary financial institutions (MFIs), i.e. financial instruments not available for direct payment (time deposits and certain types of securities), depending on the respective transaction costs, maturities and risk levels.

The currency in circulation (money outside the banks) (G), and the balance on the current accounts of credit institutions kept with the central bank (reserves of the banking system - R), constitute the monetary base (M_0).

$$M_0 = G + R \tag{2}$$

The latter means the bank accounts on which credit institutions keep the liquidity required for their day-to-day operation and which are used to meet their reserve requirements. They are collectively referred to as bank reserves.

Monetary base (reserve money) in liabilities of Central Bank is connected with foreign exchange reserves in assets of Central Bank. The ratio of these components is determined by the chosen exchange rate regime, and this choice affects the ability of monetary authority to implement an independent monetary policy.

Central banks (CB) increases or decreases monetary base by changing the levels of its assets primarily based upon foreign assets and claims on banks. Central banks uses open market operations and foreign exchange interventions. When monetary authorities buy securities, the consequence is higher monetary base, and vice versa. The role of non-banking public (households and firms) is that they make a decision how much currency it wishes to hold relative to deposits. Although open market operations and discount loans both change the monetary base, the CB has greater control over open market operations than over discount loans. The CB completely controls the volume of open market operations because it initiates purchases or sales of securities. On the other hand, when banks borrow from the central bank (using standing facilities), they decide whether to borrow funds under these conditions or not. Of course the CB sets interest rates for their loans and thereby encourages or discourages banks to borrow.

Beside monetary base (M_0), the factor that determines the money supply (M_1) is the monetary multiplier (m):

$$M_1 = m \times M_0 \tag{3}$$

The size of the monetary multiplier is determined by the actions of three parties in the economy: the Central Bank, non-banking public and the banks. We can wonder what happens to the money supply when the central bank buys securities from commercial banks. That increases the credit potential of banks and banks have an incentive to loan out or invest these funds. When a commercial bank grants the loan (based on these resources) to non-bank public, the M_1 money supply increases ($M_1 = G + D$). Furthermore, loans are usually used to meet the

obligations of the borrower, and because of that, the money eventually end up back to banks in a form of bank deposits, which again increases the credit potential of banks. This means that through a process of deposit and credit multiplication (based on the rate of required reserves and the rate of unused credit potential – excess reserves) the primary initial impulse is multiplied.

Looking at the process of deposit and credit multiplication it seems that commercial banks actually create the majority of money. However, the bank can lend an amount equal to its excess reserves. The new deposit is created when the borrower spends the money that was borrowed from the bank, and when that money comes back into the banking system.

Here we can notice that the central bank can expand the volume of deposits in the banking system by increasing reserves, and can also contract the volume of deposits by reducing the reserves. Central Bank reduces reserves by selling securities in an open market sale. This action has an effect that is similar to deposit expansion in the banking system, but in the opposite direction.

Banks influence the multiplicative effects if they hold more reserves than prescribed by the central bank (if they have excess reserves). Non-banking public affects the multiplication if it holds more cash and have a lower demand for loans.

Money multiplier links the monetary base to the money supply. If it is not stable, monetary authority will not be able to influence the money supply by changing monetary base.

Equation (4) derived from equation (3) tells us that the money multiplier is equal to the ratio of money supply and monetary base:

$$m = \frac{M_1}{M_0} \tag{4}$$

Recall that the money supply (M_1) is the sum of currency in circulation (G) and deposits (D), while the monetary base (M_0) is the sum of currency in circulation (G) and bank reserves (R). Reserves can be separated into two components: required reserves (RR) and excess reserves (ER). Introducing this into (4), it is obtained:

$$m = \frac{(G + D)}{(G + RR + ER)} \tag{5}$$

As we obtained earlier, the incentive of non-banking public to hold currency, as well as the tendency of banks to hold excess reserves is important for multiplication. In order to capture these behaviours in the expression for the money multiplier we introduce two indicators: currency-to-deposit ratio (G/D), which measures the nonbank public's holdings of currency relative to its holdings of deposits, and the excess reserves-to-deposit ratio (ER/D), which measure banks' holdings of excess reserves relative to their deposits. To include these

ratios in the expression for the money multiplier (5), we can divide numerator and denominator by D and we will get the expression (6):

$$m = \frac{\left(\frac{G}{D}+1\right)}{\left(\frac{G}{D}+\frac{RR}{D}+\frac{ER}{D}\right)} \tag{6}$$

Equation (6) contains three components. RR/D is a part of the multiplier that monetary authorities have control on through the reserve requirement mechanism, but the other two components (G/D and ER/D) are not under its direct control. An increase in the G/D causes the value of the money multiplier to decline and, if the monetary base is unchanged, the value of the money supply will decline. That is because, if households and firms hold more currency relative to the deposits, banks will have less money to lend which will reduce the multiplication of deposits. An increase in required reserve ratio (RR/D) also causes the value of the multiplier to decline because banks will have less money to lend because it will have to use it in order to maintain higher required reserves. An increase in the excess reserves-to-deposit ratio (ER/D) causes the value of the money multiplier to decline, because, if banks hold relatively more excess reserves, that means that they are not using these funds to make loans as part of the process of multiple deposit creation. Banks make the decision about ER/D ratio.

It follows from equation (4) and (6) that:

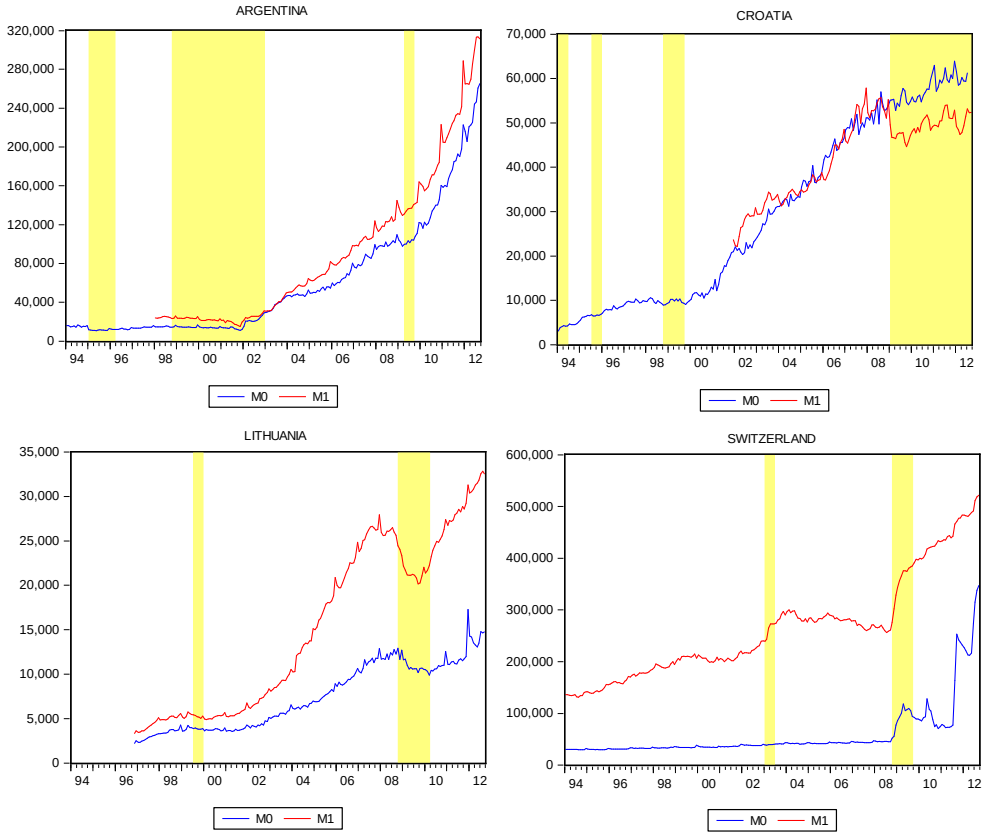
$$M_1 = \frac{\left(\frac{G}{D}+1\right)}{\left(\frac{G}{D}+\frac{RR}{D}+\frac{ER}{D}\right)} \times M_0 \tag{7}$$

This equation shows the way the money supply, measured with the M_1 aggregate, is a function of the various variables and some of them are not under direct influence of monetary policy. If we assume that monetary multiplier is relatively stable, than central bank's influence on monetary base is crucial in regulating money supply, and since the inflation process is related to the amount of money, it is practical for the central bank to influence the size of the monetary aggregates (quantity theory of money).

4. DATA AND RESULTS

If there is a significantly lower correlation between M0 and M1 during the recession this could indicate that monetary authority loses it effectiveness during the recessions. In order to determine that, the correlation coefficients for periods in recession, and for periods out of recession are separately calculated.

Input data consists of monthly values of M1 and M0 for selected five countries (Argentina, Croatia, Lithuania, Switzerland, Ukraine and the U.S.) and European Monetary Union (EMU). Criteria for selecting the country in the analysis are the data availability and the occurrence of the economic crisis. The data were obtained from IMF database (http://elibrary-data.imf.org/DataExplorer.aspx). Statistical analysis was conducted using the software package Eviews 5.0.



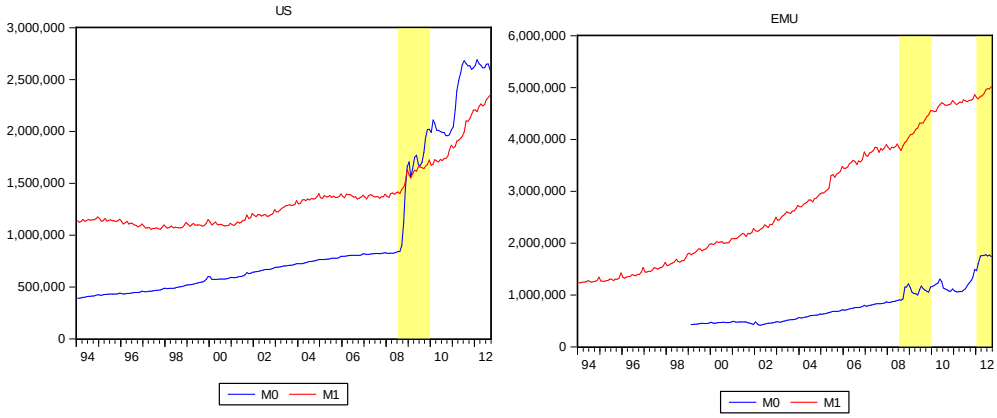


Figure 1 Movement of M0 and M1 monetary aggregates

Source: author's calculations based on data from IMF database
Note: Shaded intervals denote recession periods

In figure 1 we can see that the variables M_0 and M_1 for different countries have different movement pattern. For most countries and for most of the analysed time they have tendency to grow in tandem. For Argentina, it can be noticed that both variables (M_0 and M_1) start its exponential growth at the end of recession (in early 2003). In Croatia we have a stable (but not exponential) growth of these variables from 2000 until the beginning of the crisis in late 2008. From 2008 till the end of analysed period we have stagnation of M_1 and slower growth of M0.

In Lithuania the growth is significant from 2001 all the way down 2007 when a recession started as well as a significant decline in both variables. After the recession both variables started to grow again. Switzerland had an almost constant M_0 variable until the beginning of the recession at the end of 2008 and slow growth of M_1 variable. The graph on Figure 1 reveals that the movement of M_1 cannot be explained by the movement of M_0 variable. Switzerland significantly increased the amount of base money in 2011 when we have a crisis in Eurozone and increased exchange rate of the Swiss franc vis – a – vis euro. Because of the Eurozone crisis, too many people were buying the franc to put their money in Switzerland, which is safer than Europe. But this was raising the value of the franc, making exporting Swiss goods more expensive, and hence hurting Switzerland's economy. Because of that at the end of 2011 the Swiss National Bank decided to peg the franc to the euro at 1.20 francs for euro.

The most significant changes in the movement and relation between M_0 and M_1 can be seen for U.S. economy. Namely, Figure 1 shows a strong growth in M_0 at the beginning of the recession, and not so strong response of M_1 growth. Because of that, the monetary multiplier for US has dropped below 1 (this phenomenon can also be seen in Croatia), which indicates that in the period of

recession the association of these variables (M_0 and M_1) is reduced. In addition, aftermath the recession the reduction of M_0 does not slow down the growth of M_1, which means that in the post crisis period there is also reduced the linkage between these variables in US as well.

Finally, as far as the concerned of movement of these variables for the EMU, we can also notice (which is confirmed in further calculations) the diminished correlation between M_0 and M_1 variables during the recession, but also aftermath the recession.

Table 1

Descriptive statistics for M_0 and M_1 variables

	ARG_M0	CRO_M0	EMU_M0	LIT_M0	SWI_M0	USA_M0
Mean	59265.60	29579.32	788087.7	7466.916	57950.24	945186.4
Median	34149.19	27037.79	698391.5	6680.600	40187.00	701457.0
Maximum	265189.0	63883.65	1774568.	17279.80	347430.0	2692502.
Minimum	10783.92	3107.136	415566.0	2193.500	29480.00	390869.0
Std. Dev.	59942.12	20108.54	349192.2	3696.331	54667.75	672796.7
Skewness	1.462409	0.241606	1.048987	0.292727	3.271315	1.531049
Kurtosis	4.520026	1.471359	3.518451	1.718599	13.94157	3.927191
Jarque-Bera	101.8598	23.88177	31.91362	15.79527	1523.661	95.96366
Probability	0.000000	0.000007	0.000000	0.000372	0.000000	0.000000
Sum	13334760	6596189.	1.29E+08	1426181.	13038803	2.13E+08
Sum Sq. Dev.	8.05E+11	8.98E+10	1.99E+13	2.60E+09	6.69E+11	1.01E+14
Observations	225	223	164	191	225	225
	ARG_M1	CRO_M1	EMU_M1	LIT_M1	SWI_M1	USA_M1
Mean	91103.63	42738.62	2806306.	15238.33	263779.8	1351593.
Median	65745.75	46370.72	2561474.	13724.10	259683.0	1266000.
Maximum	313747.7	57878.27	5022864.	32836.00	521900.0	2349800.
Minimum	15087.55	22164.86	1228742.	3339.200	130951.0	1054700.
Std. Dev.	77046.24	9241.611	1214898.	9466.769	98598.24	312919.6
Skewness	1.139749	-0.413971	0.329081	0.212755	0.855712	1.506149

Kurtosis	3.492613	1.853599	1.712427	1.472791	2.890491	4.618127
Jarque-Bera	40.11098	10.83183	19.60332	20.00268	27.57154	109.6151
Probability	0.000000	0.004445	0.000055	0.000045	0.000001	0.000000
Sum	16125343	5556020.	6.31E+08	2910521.	59350445	3.04E+08
Sum Sq. Dev.	1.04E+12	1.10E+10	3.31E+14	1.70E+10	2.18E+12	2.19E+13
Observations	177	130	225	191	225	225

Source: author's calculations based on data from IMF database

Descriptive statistical analysis (see Table 1) shows that all distributions except CRO_M1 have a long right tail. In addition, the distributions CRO_M0, LIT_M0, CRO_M1, EMU_M1, LIT_M1 and SWI_M1 of view are peaked (leptokurtic) relative to the normal, while the distributions ARG_M0, EMU_M0, SWI_M0, USA_M0, ARG_M1 and USA_M1 are flat (platykurtic) compared to the normal distribution.

Jarque-Bera is a test statistic for testing whether the series is normally distributed. The test statistic measures the difference of the skewness and kurtosis of the series from those of normal distribution. The reported probability is a probability that a critical value of the Jarque-Bera is greater (in absolute terms) than the obtained value. A small probability value leads to the rejection of the null hypothesis of a normal distribution for all distributions.

Results of the correlation analysis between underlying variables are shown in Table 2

Table 2

Correlation coefficients between M_0 and M_1 in recession periods and in periods of growth

Country	Period in recession	Number of months	Correl. coef.	Period of growth	Number of months	Correl. coef.
Argentina				1994q1 1994q4	12	N/A
Argentina	1995q1 1996q1	15	N/A	1996q2 1998q3	30	N/A
Argentina	1998q4 2002q4	51	0.800793	2003q1 2009q1	75	0.986323
Argentina	2009q2 2009q3	6	0.807790	2009q4 2012q3	36	0.992642
Croatia	1994q1 1994q2	6	N/A	1994q3 1995q2	12	N/A
Croatia	1995q3 1995q4	6	N/A	1996q1 1998q3	33	N/A
Croatia	1998q4	9	N/A	1999q4	111	0.960505

	1999q3			2008q4		
Croatia	2009q1 2012q3	45	0.642637			
Lithuania				1994q2 1999q2	63	0.983635
Lithuania	1999q3 1999q4	6	0.818966	2000q1 2008q3	105	0.990192
Lithuania	2008q4 2010q1	18	0.751739	2010q2 2012q3	30	0.854698
Switzerland				1994q1 2002q4	108	0.917542
Switzerland	2003q1 2003q2	6	0.816546	2003q3 2008q3	63	0.311789
Switzerland	2008q4 2009q3	12	0.844648	2009q4 2012q3	36	0.893080
U.S.				1994q1 2008q2	174	0.897597
U.S.	2008q3 2009q4	18	0.761177	2010q1 2012q3	33	0.887823
EMU				1996q1 2008q2	150	0.972380
EMU	2008q3 2009q4	18	0.444749	2010q1 2011q4	24	0.506395
EMU	2012q1 2012q3	9	0.479378			

Source: author's calculations based on data from IMF database

Table 2 and Figure 1 show that, among the analyzed countries including EMU, Croatia had the highest number of recession (four) and together with Argentina, Croatia had one of the highest number of quarters in recession (66 months Croatia, and 72 months Argentina). Other countries recorded two or only one period in a recession with an average number of 21.75 months in recession. In some countries strong correlation between M_0 and M_1 variables can be noticed, and for other countries this relationship is weaker (EMU, Switzerland). Nonetheless, for almost all analysed countries (except for Switzerland) the connection between M_0 and M_1 was lower during a recession compared with period out of recession, or compared with period aftermath the recession. To statistically confirm that, we can implement the *t*-test. In our sample we have ten correlation coefficients for recession periods and 13 correlation coefficients for periods without recession. In order to test hypothesis of equality of means we can use expression (8).

$$Se\left(\overline{X}_1 - \overline{X}_2\right) = \sqrt{\left(\frac{n_1 \cdot \hat{\delta}_1^2 + n_2 \cdot \hat{\delta}_2^2}{n_1 + n_2 - 2}\right) \cdot \left(\frac{n_1 + n_2}{n_1 \cdot n_2}\right)} \tag{8}$$

The data for calculation are summarised in table 3.

Table 3.

Data for calculation *t*-test

	Mean of R	n	σ
Periods in recession	0.716842	10	0.145731
Periods out of recession	0.858046	13	0.208299

H0 and H1 hypothesis are:

$$H_0 : \ldots\ldots \overline{X}_1 - \overline{X}_2 = 0$$
$$H_1 : \ldots\ldots \overline{X}_1 - \overline{X}_2 \neq 0$$

t-test of acceptance hypothesis H0 is:

$$t^* = \frac{\overline{X}_1 - \overline{X}_2}{Se\left(\overline{X}_1 - \overline{X}_2\right)} = \frac{0.716842 - 0.858046}{0.00654132} = -21.58647$$

t_{tab} = 2.080 – probability of *t*-distribution, with df = 21 and α=0.05

$$\left|t^*\right| > t_{21}^{0.05} \Rightarrow \text{we reject } H_0$$

Obtained results of *t*-test confirms the significantly different correlation coefficients between analysed series, and that proves our initial thesis of the reduced ability of monetary authorities to influence the money supply by changing monetary base in period of recession. That fact could be the obstacle for channelling monetary measures toward real sector and should be taken into the consideration in process of decision making.

3. CONCLUSION

This research shows that in period of crisis monetary authority hampered controlling the movement of the money supply. The reasons for that we can find in changed behaviour of banks and non-banking sector (households and businesses). Namely, in periods of crisis and uncertainty banks are reluctant to grant the loans to households and to businesses as well because of increased credit risk and because the deterioration in their balance sheets. Additionaly, because of rising unemployment and fear of job loss, households demand for loans stagnated, and in a same time they start to withdraw money from the bank causing the bank crisis. The overall result of that is the increase of currency-to-

deposit (G/D) and excess reserves-to-deposit (ER/D) ratios and consenquently the decline of money multiplier and money supply.

The obtained results of the reduced effectiveness of monetary policy in periods of economic crisis that arising from reduced money multiplier does not mean that there is no reason to use monetary tools to cope with the crisis. On the contrary, the results suggests that when making the decisions about certain monetary measures it should be taken into the consideration the reduced effect of the policy actions that was experienced in periods of crises. So, if the goal of the monetary authority is to offset the contractionary effects of a financial crisis, then it should pursue more aggressive monetary policy than usual, but it should also prepare the exit strategy in a case of high inflation.

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